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WASHINGTON, D. C.

VOL. XIII, No. 10 WASHINGTON OCTOBER, 1902

THE NATIONAL GEOGRAPHIC MAGAZINE

OUR NORTHERN ROCKIES

BY R. H. CHAPMAN,

UNITED STATES GEOLOGICAL SURVEY

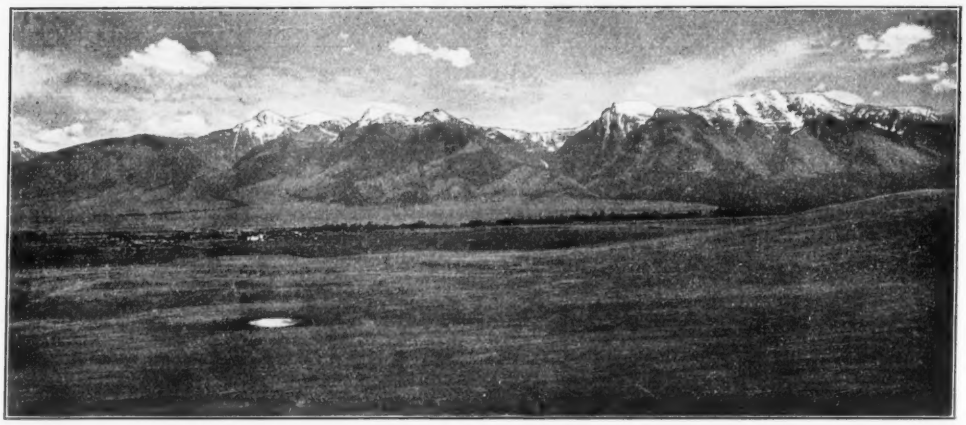
IF a line be drawn dividing the State of Montana about the middle of its east and west extent, the mountainous area will be to the west and the plains to the east of it. In the mountainous region the Government has reserved certain areas for the protection of the forests, and much of the region I shall describe lies within the Lewis and Clarke Timber Reserve.

The area of this reserve is about 6,000 square miles and covers both flanks of the Continental Divide, which here separates the waters of the Columbia and Missouri rivers, and so includes the main Rocky Mountain range. The major portion of it is mountainous, and lies between the Flathead Valley to the west and the great plain of the Missouri to the east, which stretches for a hundred miles, a sharp contrast to the ruggedness of the reserve. In these valley areas are towns, ranches, roads, and fences—marks of civilization. In the Reserve rough trails and a few Indian camp-grounds, marked by a number of "teepee" poles, are about the only culture features, although there are a few cabins.

It is our purpose in entering the reserve to visit prominent mountain peaks to build cairns or signals of timber on their summits, to make the necessary observations to enable us to locate by triangulation these signals, and to compute the latitude and longitude, distance and directions, from other known points. These signals are to be used by the topographers in mapping the reserve.

It is also necessary to make sketches of the route traveled, the existence and condition of trails and camping places, to make note of burned areas, and to get as much general information as possible of this wild region.

I shall ask you to imagine yourselves making a journey with me on horseback, our limited baggage and many weeks' supplies packed on the backs of mules. To such places as we cannot ride and drive our train, we will take our loads upon our own backs and travel on foot. We will pass through the Flathead Valley, take a course approximately northeast until, passing the many ranges which make up the Rocky Mountain backbone, we emerge upon the plain of the Missouri River.



Flathead Valley. Mission Range in background

The Flathead Valley is of considerable area—open, grassy, and rolling, dotted by ponds and lakes, the largest being Flathead Lake, which is about 30 miles long, 5 to 12 miles wide, and about 2,900 feet above the sea.

This region is one of the best in the state for raising grains and the hardier fruits; it requires little or no irrigation, as there is an abundant rainfall. It is largely within the Flathead Indian Reservation, through which we pass en route to the mountains beyond. The Indians, gathering from all directions to celebrate the holiday of the Fourth of July in dancing and horse-racing, call to us to stay and pitch our tents in the circle and "have some fun;" but on we go, the mountains to the west and south—rolling and beautiful—straight up the narrowing canyon toward the Mission Range, which rises to the east, directly in front of us. Here are blossoms and grass in profusion, stately trees, and grateful shade.

The summits of the Mission Range gradually increase in height toward the south and culminate in McDonald Peak, which is about 10,000 feet above the sea. This peak wears perennial snow, has several glacial remnants, and is difficult of ascent late in the season after heavy snows. The peak is one of the triangulation stations of the Geological Survey, and I have attempted to climb it on four occasions, the first and the last being successful. The unsuccessful attempts were made in October and November; the successful ones in July and August.

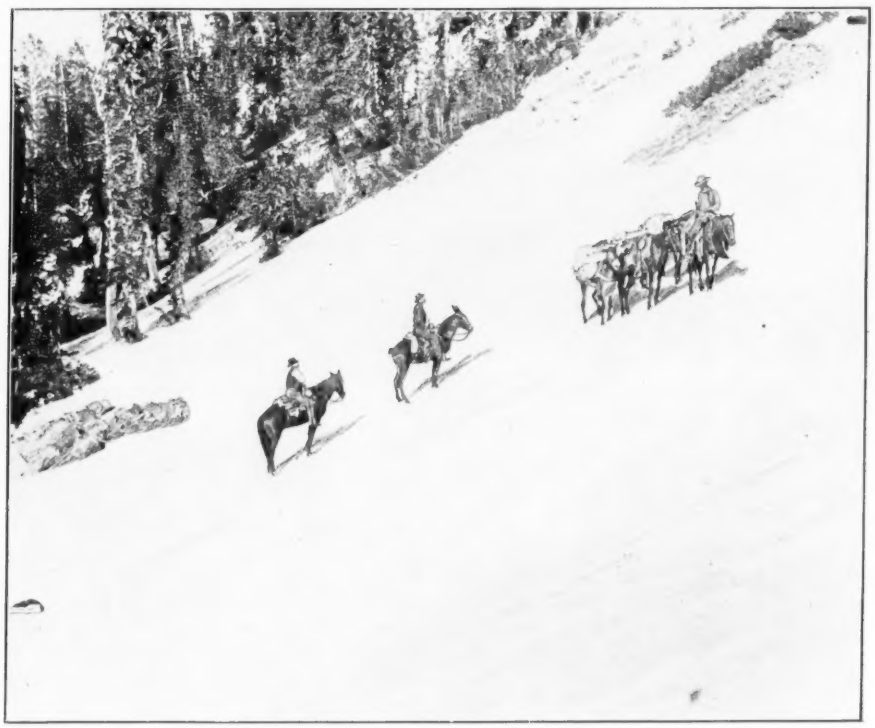
As we ascend we cross many snow banks, and eventually make our camp high in the range at the most available spot, where there is only five feet of snow—a sharp contrast to the valley behind us. Our horses and mules are fed a few handfuls of grain—"to keep them cheerful," as the packer says—and we start for the pass and peak (McDonald) by the easiest route, a wearying one at best. We skirt the cliffs, have superb views on every hand, the problem always in front of us white and forbidding. After many hours of steady but not dangerous climbing, we at last stand on the summit, gazing from the midst of winter to the sunny plains of summer, miles away and thousands of feet below. We are wet to the skin, and the wind penetrates all the clothing we can wear, so that the return is begun as soon as possible.

The weary climbing through heavy snow is replaced by long, exhilarating slides down the hard slopes, the spike of the alpenstock scratching a deep track in the snow and our knees aching with the long tension, and at nightfall we reach camp, to find that every gunny-sack, many saddle blankets, and the front of my waterproof coat have all been eaten by the hungry mules.

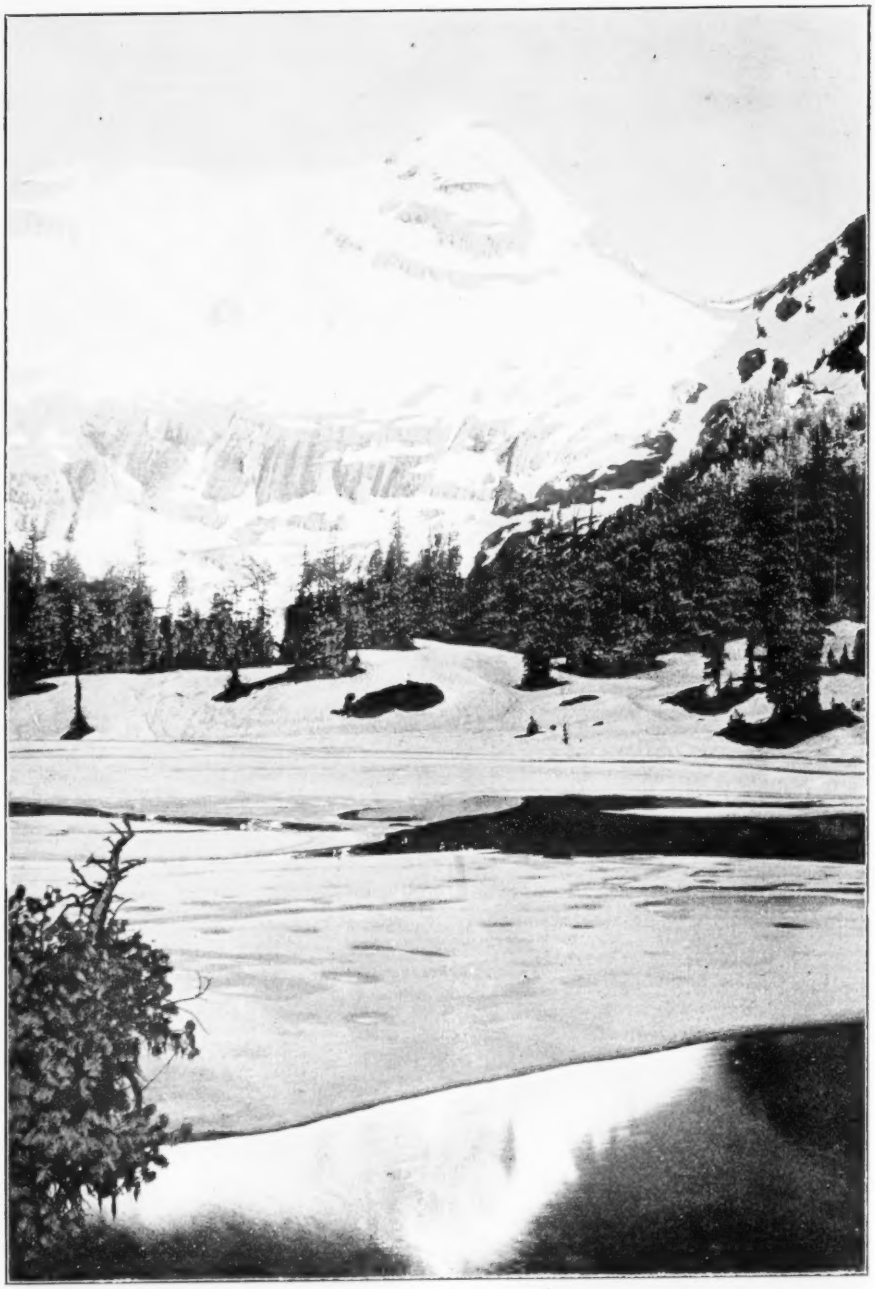
The Mission Range is the westernmost of the several ranges which collectively represent the Rocky Mountains, and it receives more rain and snow than the ridges to the eastward, being the first to intercept the moisture-laden winds from the southwest. The range is much steeper on the western slope than on the eastern, which is accounted for by the geologic structure; but at the top of the ridge so much glacial erosion has taken place, so many amphitheaters and deep gorges have been cut, that the crest is broken into a number of isolated peaks.

We find it is made up of a series of limestones, which dip to the northeast, with some quartzite and intrusions of igneous rock, the west face being a fault plane. The stratification and dip of the beds are clearly shown in the view on page 371. This may be taken as a type of the ranges west of the Continental Divide.

To the east of the Mission Range lies Swan Valley, extending some 55 miles north and south and being about 10 miles wide. It is drained by Swan River, which heads in the snow and ice fields of the Sin-yel-a-min Peak and Jocko Crags and flows northward for a time in a narrow, ice-cut gorge, now



"We start for the pass and peak (McDonald) by the easiest route"



McDonald Peak from East. Lace Lake in Foreground

occupied by Long or Elbow Lake, then through a wide, gently graded valley to Swan Lake, which in turn empties into the Flathead River. This valley is flat and U-shaped, has many ponds and small lakes, and is densely timbered, with many small "parks," grassy and beautiful. Several days are consumed in making the descent to, and crossing the Swan Valley, as it is difficult to accomplish in an east and west direction. The timber and trails are in many places choked by wind-fallen trees, and our animals are jumping these logs, their legs scraped and bruised; but they are well fed, as grass of the best quality is found in many open meadows. The river, flowing over gravels and sand, abounds in fish, and we feel that we are in a camper's paradise.

The range to the east of this valley is the Swan Range. It is the highest and least broken ridge in the region, the higher peaks rising to ten and eleven thousand feet. It extends from the south line of the reserve to a point northeast of Kalispell, where it is cut by the Flathead River in a gorge named "Badrock Canyon," and through which the Great Northern Railway passes.

Like the Mission Range, the Swan is steeper on the west slope. The rocks dip to the northeast, and are folded and fractured on a large scale, and superb views are constantly coming before us. Our trail up this slope is plain, but steep and hard, and when the pass is reached we are four thousand feet above the valley. Stunted pines and scanty grass surround us here, lakelets dot the bottoms of the narrow gorges, and the mighty peaks rise far above us. To reach these peaks we find that the route to travel is along the ridge. The cliffs are about 1,000 feet high. We remember that while trying to reach the Holland Peak in 1900 this ridge was so covered with glare ice as to be impracticable; a long detour was necessary and the total climb of about 8,000 feet so wearying, that one man collapsed as we returned in the darkness. We could not leave him to sleep with no awakening, in the snow, so rolled him in canvas, fastened ropes to his feet and shoulders, and tobogganned him down 2,000 feet to a frozen camp.

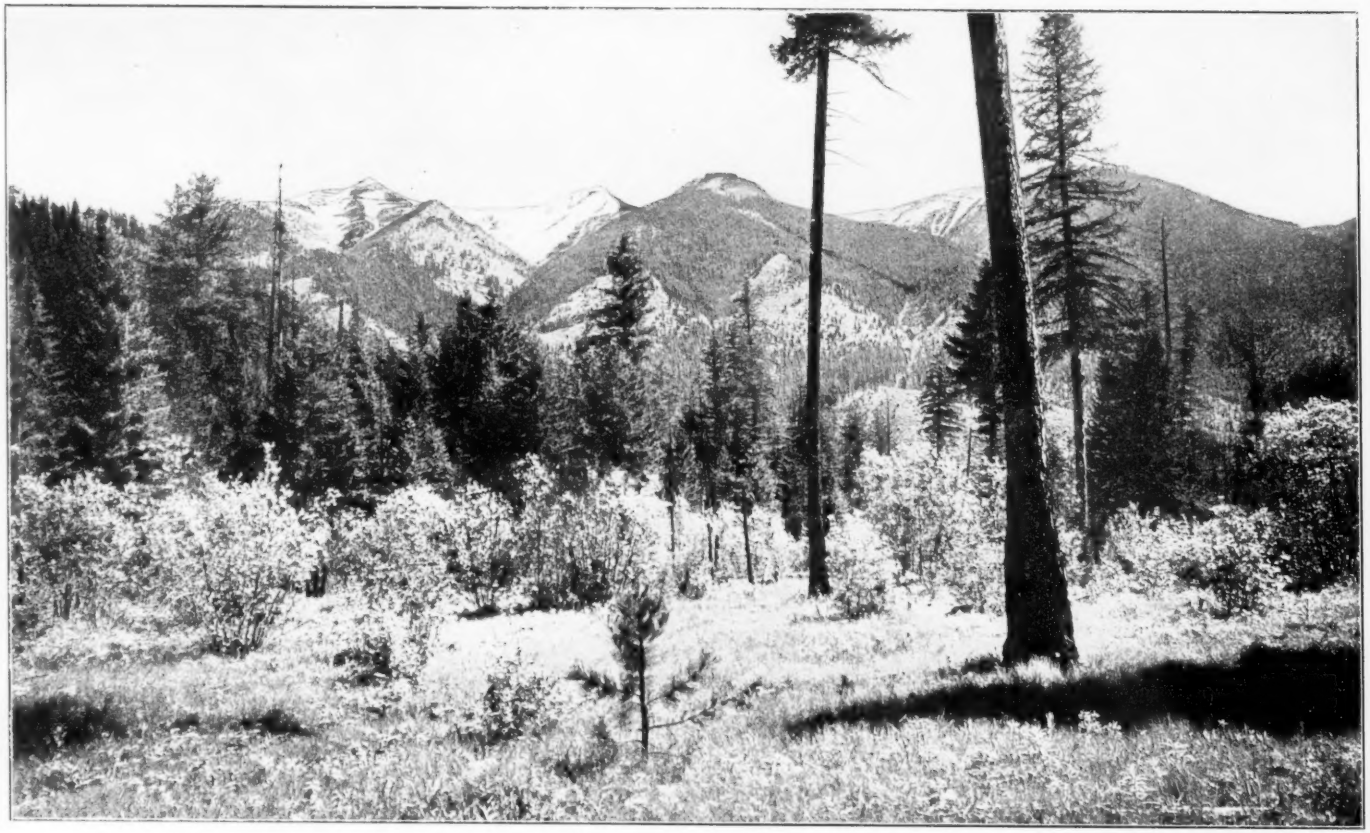
The eastern slope of the Swan Range we find to be in the nature of a bench-land cut deeply by gorges and canyons eroded by local glaciers, of which only the remnants remain.

The Swan Peak is the highest of the range (about 11,000 feet), and the largest ice mass of this range flanks it.

The Swan Ridge is the western rim of a large basin drained by the South Fork of Flathead River, and the descent to the valley is long and rough and the trails much choked by fallen timber. Our route is across the shelf lying between the crest ridge and the final steep slope of the valley proper, which is heavily timbered. There is a trail the whole distance from the head to the mouth of the South Fork, but no novice must attempt to follow it.

At a point east of the Holland Peak the valley of the South Fork of Flathead is broad, flat-bottomed, and covered with fine, open timber and with grass, and at this point our trail follows the river bottom or ascends to the slopes of the gravel deposits flanking it. Here we find evidence that the indomitable prospector in his quest for wealth has anticipated our arrival. His cabin is decaying and his tunnel-mouth caving in, and we find that coal is his ambition, from the nature of the material on the river bank.

Many miles below, where the stream crosses several limestone ridges, it runs in a sharp "box" canyon, and the trail, which follows the canyon brink quite closely, is difficult and dangerous; it is sometimes *in* the water and at others eight or nine hundred feet *above* it. It is often a great problem to get animals across the canyons in which the



Mission Range. Sin-yel-a-min Peak from high Park South

Erosion of Limestone near Silvertip Peak

"A pavement not calculated to increase our rate of travel many miles per day"

side streams join the main river, and to cross the river in these canyon districts is impossible. When the water is high, traveling in this valley is out of the question. At one point the whole river, when at low stages, flows in two channels, each not more than five or six feet wide, which may be crossed dry shod by springing over them, though the water is 50 feet or more in depth.

Unlike the Swan River, the South Fork is doing much work in cutting a way through the limestones and shales which it encounters, the canyons being picturesque in the extreme.

The ridge next to be scaled to the east of the South Fork is the Continental Divide—the watershed of the Rockies, which is flanked by numerous spurs or parallel "rampart" ridges, shown in the views taken from the Silvertip Peak. This peak we have found to be easily climbed, the pack-mule carrying instruments to within 500 feet of the top. It is a huge mass of limestone on top of a plateau guarded by long lines of cliff, with sentinel peaks at every approach. The plateau is almost devoid of vegetation, the surface being worn into innumerable channels by the waters running from huge snow banks, a pavement not calculated to increase our rate of travel many miles per day.

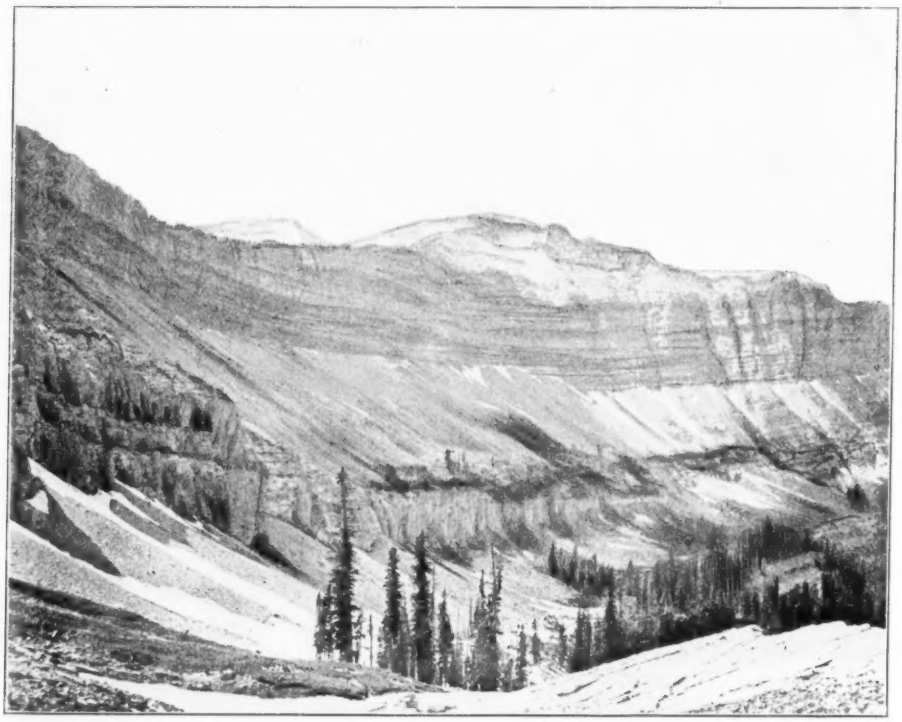
Upon reaching the summit of the Divide we discover that the cliffs which we have continuously scaled or circled, and which face southwest, are replaced by similar ones facing northeast, so that our difficulties, which have been of *as*cent, become ones of *de*scent, and may

in many places be accomplished with no effort, little fun, and less comfort, unless great care be taken. Continuing in our northeasterly course, we reach the headwaters of the River of the Sun by a rough trail—great peaks, now of limestone, light yellow, buff, or bluish in color, and again of shales, red, green, and slate color, on every hand. The Sun River was named by the Indians, some say on account of the brilliance of the light, due to reflections from the many cliff walls in the upper reaches and from the open, light-buff-colored plain east of the mountains. It was long used as a gathering point for the tribes east of all the ranges for the "sun dance." It might well be named for Æolus, as its canyon serves as a funnel through which all the "winds of heaven" rush forever.

In the valley of Sun River are numerous hot springs and *deposits* of springs long since extinct. The Indians use the waters of these springs for drinking and bathing to cure many ailments, and today the location is one frequently visited by camping parties from the valley towns.

The Sawtooth, or Sun River Range, divides the upper branches of Sun River from the Missouri plain, and is the east front of the Rockies. The rocks of this range are largely light-colored limestones, and are faulted and eroded into a series of ragged, sharp peaks rising abruptly, and are very impressive.

From the divide until the open plain is reached the Sun River crosses no less than twelve ridges, usually of limestone (but sometimes igneous rocks), and cuts a canyon through each, similar to



Continental Divide. East Face of Cliff near Silvertop Peak

Continental Divide—Pentagon Peak (Limestone)

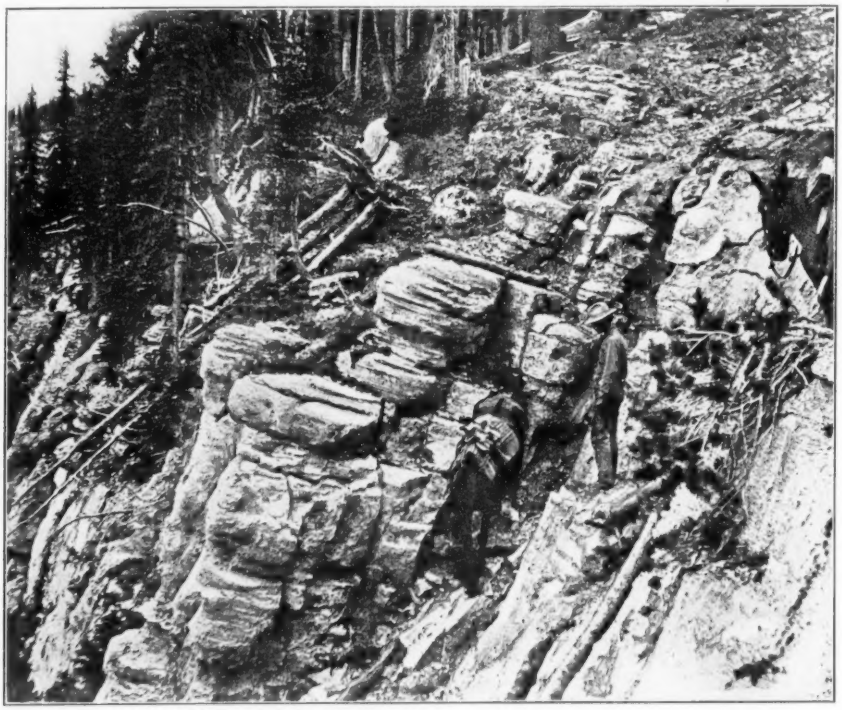
those described in the valley of the South Fork of Flathead.

The abruptness of the ranges to the east of the Divide and the lines of continuous cliff, make the trails across them steep, slippery and dangerous, and detours of many miles are often necessary in order to cross some unbroken line of cliff. We find a trail which we built as long ago as '97, since used only by elk and deer, and which is still in condition to use ; and at last the pack animals are safely over it. During our journey we have found many difficulties—cliffs and canyons in the mountains, and in the valleys the problem has been to make our way through dense forest growths, often complicated by large areas of wind-fallen timber and sometimes by swampy ground, or all three of these conditions at the same time, when the problem has been well-nigh disheartening. We are sometimes confronted with the débris of a snowslide, which makes no small delay in our progress toward the objective point. We have found large areas that have been burned over by forest fires, which transform live, cool forests into desolate tangles of dead trunks, and we have passed through fires, smouldering, which would have become a raging conflagration with the advent of a heavy wind, a by-no-means uncommon thing in the mountain districts. These fires are often started by Indians, out hunting, who build smudges to protect their horses from the big flies and mosquitoes, and so prevent the animals from stampeding. These insects are a terrible affliction to

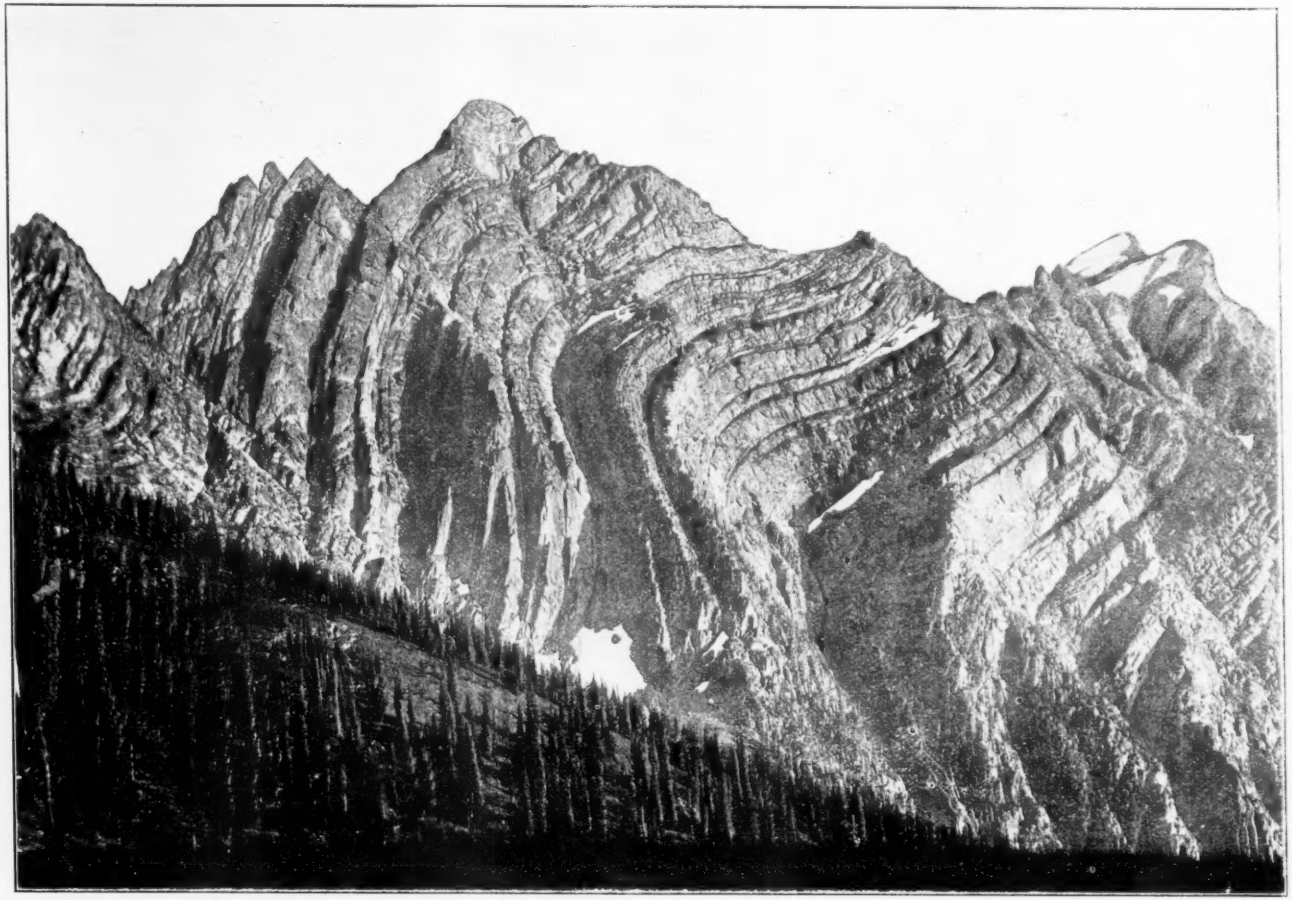
both men and beasts, and are omnipresent in the valleys during July and August.

We have found that the weather condition at any given time is of no small importance in endeavoring to prosecute work in this region. In the mountains snow may fall at any time; July and August are by no means exempt from snow squalls, and September will always bring a storm. New snow, whether falling or lying, will always be no small factor in the difficulties attending a climb. In October, 1900, the party made three attempts to reach the summit of the "G. N." Peak. The third was successful, but during the second attempt slides of no mean proportions passed, one a few yards ahead and one but a few, behind the party. These slides were of the newly fallen snow, and passed over smooth rock surfaces with a comparatively slow motion, the front of the moving mass turning under as the breakers do on the beach at the seashore; the sound was a "shush" of low tone but goodly volume. If caught by one of these a man would be rolled over and under and inevitably smothered.

But the time has come when provisions are exhausted, and the leader of the pack-train is turned toward the nearest accessible point of supplies. At the first cabin—a halfbreed's—we obtain a little tobacco and flour, enough to carry us to the store. The mountains are slowly left behind us, and low ridges, much scarred by forest fires, the usual accompaniment of approaching civilization, give way in turn to the grassy hills and finally to the open plain,



Pack Train Crossing Limestone Cliff on Trail Built of Green Timber



Folded Strata Just South Heaves Peak. From Snow Bank to Summit is about 2,000 Feet

Missouri River Plains and Pack Train

"The mountains are slowly left behind us . . . and our eyes, so accustomed to crags and peaks, look upon an apparently boundless prairie, blazing hot, dusty, and shadowless"

where our eyes, so accustomed to the crags and peaks and such limited horizons, look upon an apparently boundless prairie—blazing hot, dusty, and shadowless; but with letters and news of the world's doings at the post-office.

The fascination which is born of exploration and travel in a great mountain region never quite leaves one, and the northern Rockies are a field worthy of any man's study. The diversity of the demands upon him, the inspiring scale upon which his surroundings are builded, make human accomplishment seem, in a measure, vain; but there are obstacles to be overcome, requiring all his attention and effort; streams to be forded, glaciers to pass, cliffs to be scaled, and mighty walls, measured by thousands of feet, tempting him to greater efforts, fitting monuments if he fails.

LIMITING WIDTH OF MEANDER BELTS

By Prof. Mark S. W. Jefferson,

State Normal College, Ypsilanti, Michigan

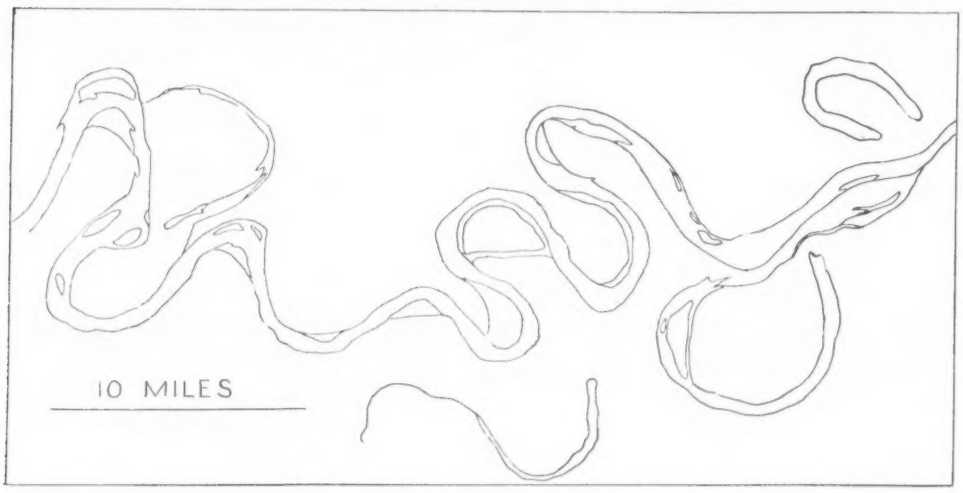
"One of the most characteristic features of streams, whether large or small, is the tendency to wind in serpentine curves when the angle of declivity is low, and the general surface of the country tolerably level."—*Seikie: Text Book of Geology, 3d ed., p. 387.*

"The Meander, a serpentine river of Asiatic Turkey, has given its name to this river habit. . . . The size of the meanders increases with the volume of the stream. A meadow brook may swing around curves measuring only 40 or 50 feet across. The curves of the lower Mississippi are from 3 to 6 miles across."—*Davis: Physical Geography, pp. 213-214.*

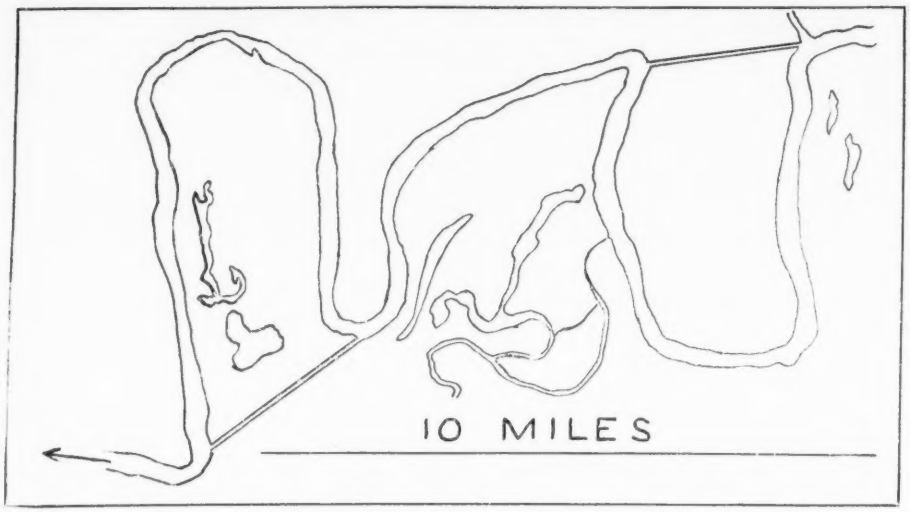
THE present paper seeks to establish a limit for the width of the belt of meanders of any given stream and finds that limit to be eighteen times the mean width of the stream at the place, the depth of water and the volume of stream discharge being negligible in the present state of geographic knowledge.

If we examine the course of any well-mapped meandering river, as the Mississippi at Greenville, Miss., we shall observe that it is very irregular.

Stretches of wide-swinging meanders alternate with stretches of wavering course, where the river trends along a straight line, but with tremulous leanings to one side or the other. These wavering stretches are further embarrassed by sand bars and islands flung into the river's path in disorder. The meandering stretches are distinguished by a more positive, self-assertive character, the sand bars are pushed mostly to the inner bank, while the channel hugs the outer at each curve. But here, too, is a certain hesitancy in the sweep of lines, suggestive of numerous factors of control. Even disregarding these minor waverings, the meanders display great variety of type and dimension within short distances. Along the Mississippi may be observed circles of differing radius, ovals and ellipses distorted



The Mississippi at Greenville



The Theiss, Basin of Hungary

in every conceivable direction with respect to their own axes and the trend of the river. Certainly there is great diversity, even appearance of disorder, here.

But when the processes that are changing geographic forms are studied, system and law become at once more evident; not that the process is more systematic or observant of law than the resultant forms, but only a mind conscious of process can perceive the systematic element in the forms. At every bend is the stream-cut bluff without and growing sand bar within. Along each wavering stretch lie the oxbow lakes and sloughs to right and left. Everywhere are seen signs that the river, wandering too far to right and left in its meandering stretches, recovers itself by cutting off loops it has planned beyond its powers, to again stagger aimlessly, gathering momentum across its valley as its thread rebounds from bank to bank and presently begins meandering anew.

To measure the width of the belt of meanders between lines tangent along the swings of the river to right and left is to measure a varying quantity that finds its minimum in wavering reaches and its maximum in some strong group of meanders. This value must be selected as characteristic of the river, since the river's swinging tendency finds in it its fullest expression.

There are many difficulties in the measurement of meander belts. In practice, judgment is aided by the presence of cut-off loops and by the empirically determined fact that streams rarely attain their maximum width of meander until the belt is two or three times as wide as the successive loops are distant along the general course of the river. This ratio is given for the rivers for which data are tabulated at pages 378 and 379 under the heading $\frac{mb}{d}$, or meander belt divided by distance. It gives an excellent idea of the stage of development of any system of meanders.

WHY VOLUME IS NEGLECTED

We have very little accurate knowledge of stream discharge to obtain good data for the rivers that are otherwise suitable for meander study.

The following is a brief outline of method and result of an attempt in this direction. Three streams were first considered as having mature meanders on flood plains of very slight inclination. They were the tiny Matfield at Elmwood, Mass., the moderate Oder at Kosel, Silesia, and the giant Mississippi at Greenville.

The Matfield was carefully mapped for this purpose.

Essential quantities, such as the meander belt, were measured directly on the ground. As run-off could only be determined by observations through a long series of years, I thought it better to utilize the results already obtained by 36 and 19 years respectively of observations in the neighboring Mystic Lake and Lake Cochichuate watersheds. I obtained the results from Water Supply and Irrigation Paper No. 35, page 39, that on those basins the run-off was respectively 1.49 and 1.46 cubic feet of water per second for every square mile of surface. As the Matfield basin above Elmwood Village bridge has an area of about 43.5 square miles, making allowance for the water diverted to the use of the city of Brockton, I estimate its run-off at an average of 63 cubic feet per second. The meander belt is about 450 feet wide.

For the Oder we learn from Der Oderstrom, Berlin, 1896, map 11, that there is a typical recent cut-off at Kosel. The meander belt is 4,688 feet wide. The same work puts the Oder's discharge for mean stages, with the Kosel gage reading 1.29 meters, at 1,907 cubic feet per second. According to a table by Loeschmann, Beiträge zur Hydrographie der oberen Oder, page 55, this corresponds to an average annual flow of 2,407 cubic feet per second. This is probably too small a quantity, as the volume discharged at high stages must have a far greater departure from the mean than that at low stages.

The Mississippi data are from Park Morrill's Floods of the Mississippi River, Report of the Chief of the Weather Bureau, 1896–'7, page 391 and plate IV. Adding the drainage of the upper Mississippi, Ohio, Missouri, and Arkansas basins to A, B, C, and $\frac{2}{3}$ D in the Central Valley, I estimate the discharge at Greenville at 570,000 cubic feet per second. From sheet 14 of the preliminary map of the lower Mississippi it appears that the meander belt attains a maximum width of 55,000 feet at that point.

Since the doubtful data for these streams was all I had access to for maturely meandering streams, I looked for what confirmation might be had from various rivers not on typical flood plains, but flowing in inherited meanders now incised in the region of Appalachian and Alleghany uplifts. I found run-off estimates for these streams in F. H. Newell's Hydrographic work, Nineteenth and Twentieth Reports of the Director of the U. S. Geological Survey, section Hydrography. Meander belts were measured on the topographic maps of the Geological Survey.

To show the departure of these streams from the flood-plain type the feet of descent per mile have been included in the table in the column headed *f; mb* heads that containing widths of meander belts in feet, while *md* heads the column of discharges in cubic feet per second.

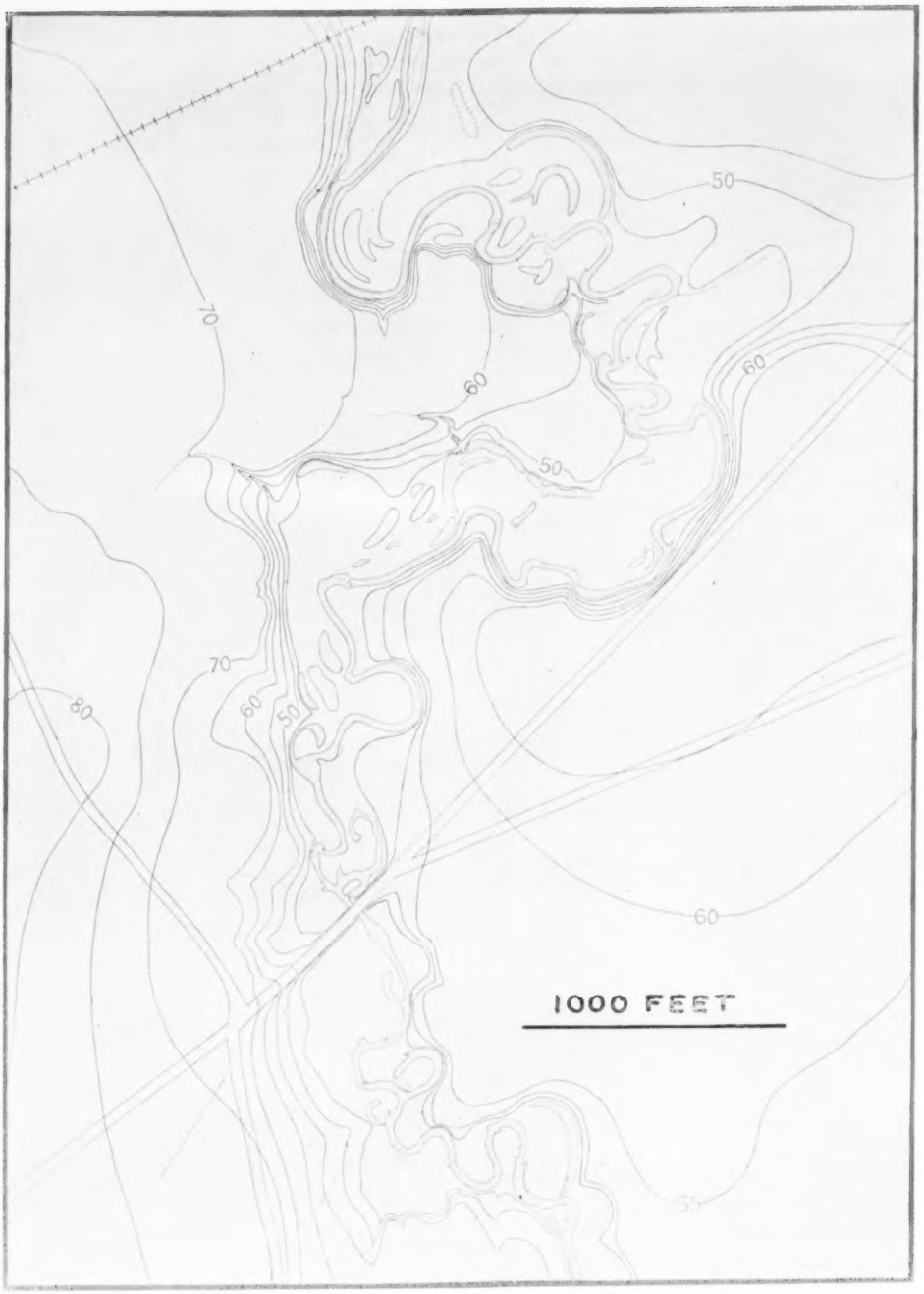
A—ON FLOOD PLAINS

	f	*mb*	*md*	
Matfield	.....	450	63	Elmwood, Mass.
Oder	...	4,688	2,407	Kosel, Silesia.
Mississippi	.....	55 000	570,000	Greenville, Miss.

B—INCISED

Etowah	6.4	4,000	1,134	Canton, Ga.
James	7	8,448	1,779	Buchanan, Va.
Greenbrier	7	9,768	2,080	Alderson, W. Va.
Shenandoah	3	9,000	2,700	Near Potomac River
Tennessee	*	26,400	40,000	Chattanooga, Tenn.

*Less than a foot.



The Matfield at Elmwood, Mass.

Calling the Tennessee comparable to the first three rivers because of its moderate descent, we may construct a curve with discharges for ordinates and meander belts for abscissas. The curve is, however, determined at points too few and badly placed to be of much value. The following selected quantities indicate well enough its character:

md	*mb*
0	0
500	1,400
1,000	2,600
5,000	7,000
10,000	10,700
50,000	28,000
100,000	33,500
500,000	54,000

That is, the larger the volume of water discharged by a river, the wider its meander belt, but the *differences* in width are less as the rivers are greater in volume.

The data for incised rivers do not fall into this curve. Such data do not suffice to establish definite relations.

SOME THEORETICAL CONSIDERATIONS

Stream volume is a function of width, depth, and velocity. Maturely meandering streams may be regarded as finding their slope too steep. As this gave them more energy than was needed to carry their load of waste seaward, they employed the excess in cutting sidewise, forming meanders until their slope was thus lengthened and flattened to their taste. The Mississippi travels 80 miles along its winding channel in flowing from Greenville to a point 45 miles due south. In so doing it reduces its descent from 7 inches to 4 inches per mile. When a cut-off thwarts further lengthening of the course, we must suppose that the proper slope has been already reached. So maturely meandering streams will have courses tending to a minimum of inclination, differing with each other chiefly as they carry more or less silt. It is probable that meander-cutting, like all other erosive work, is chiefly effected at recurrent moments of more intense activity. Perhaps there is never a cessation of the cutting on the outer bluff; yet the greater part of the work will be done at times of swollen waters. At these moments the streams are burdened with silt to their utmost capacity, all of them alike and each of them in its mean thread of flow. The swift outer reaches are still eager to take more earth from the bank, while every check within a bend is the scene of active deposition. As the load of silt determines the slope needed for its transportation, here is another agency tending to uniformity of slope in all streams with well-developed meander systems. These considerations look to the elimination of velocity as a constant factor in the volume of the stream; there remain as varying factors width and depth.

We cannot assert that at the time of most effective meander-making depth, too, is a constant, but there are considerations which tend to show it has little effect on the width of meander belts.

The width of a meander belt depends immediately upon the sharpness with which a stream can turn a corner. Generally speaking, the longer the radius of curvature, the wider the belt, and the shorter the radius, the narrower the belt. The stream's difficulties in turning increase with the stream's width quite apart from its depth.

Material cords and cables offer some interesting analogies. A thread may be doubled sharply on itself, a string less sharply, while a large rope or cable can only be bent in a wide, open turn. The difficulty is with the inside strands. The thicker the rope, the more there are of them, and the more they insist on taking up room and holding the bend open. If a board is to be bent sidewise, an in-

TABLE A.

River.	Scale.	*mb*	*w*	$\frac{mb}{w}$	$\frac{mb}{d}$	Place.	Map.
1. *Mississippi	$\frac{1}{63360}$	55,000	2,830	**19.4**	3.2	Greenville, Miss.	Sheet 14, preliminary map.
2. *Matfield	$\frac{1}{1200}$	450	30	**15.0**	2.6	Elmwood, Mass.	Abington, Mass., and p. 376.
3. *Oder	$\frac{1}{25000}$	4,688	243	**19.3**	2.2	Kosel, Silesia	Der Oderstrom, Karte 11.
4. Oder	$\frac{1}{50000}$	8,335	416	**20.0**	.....	Breslau, Silesia	Der Oderstrom.
5. *Rhine	$\frac{1}{100000}$	22,925	1,250	**18.3**	3.5	Above Worms	Der Rheinstrom, Karte 13.
6. *Rhine	$\frac{1}{100000}$	16,667	787	**21.2**	2.6	Above Speyer	Der Rheinstrom, Karte 13.
7. Yssel	$\frac{1}{50000}$	8,963	417	**21.5**	1.4	Doesburg, Holland	Arnhem, 40.
8. Meuse	$\frac{1}{50000}$	13,702	625	**22.0**	3.2	Megen, Holland	Rhenen, 39.
9. *Danube	$\frac{1}{200000}$	25,680	1,389	**18.0**	4.0	Latitude 46° 27′	37° 46°, Maria Theresiopel.
10. *Meuse	$\frac{1}{50000}$	7,292	382	**18.1**	2.5	Latitude 51° 10′	Roermond, 58.
11. *Dniester	$\frac{1}{200000}$	6,944	422	**16.4**	3.0	At mouth	48° 46°, Odessa.
12. *Dniester	$\frac{1}{200000}$	5,555	389	**14.3**	3.5	Latitude 49° 20′	42° 49°, Stanislau.
13. *Theiss	$\frac{1}{200000}$	18,611	694	**27.0**	2.5	Latitude 46° 57′	38° 47°, Szolnok.
14. *Gardon	$\frac{1}{80000}$	6,780	422	**16.0**	(?)	Latitude 43° 51′	État-Major, 222.
15. Save	$\frac{1}{200000}$	12,840	833	**15.4**	2.3	Latitude 45° 5′	36° 45°, Brod.
16. *Drau	$\frac{1}{200000}$	9,360	833	**11.5**	2.5	Latitude 46° 0′	35° 46°, Bellovar.
17. *Urbas	$\frac{1}{200000}$	4,280	278	**15.4**	4.0	Latitude 45° 2′	35° 45°, Banjaluka.
18. Una	$\frac{1}{200000}$	7,487	555	**13.5**	3.6	Latitude 45° 15′	35° 45°, Banjaluka.
19. Tagliamento	$\frac{1}{200000}$	7,487	361	**20.8**	3.0	Latitude 45° 44′	31° 46°, Trieste.
20. Panaro	$\frac{1}{75000}$	3,100	188	**16.5**	3.3	Latitude 44° 37′	Bologna, 87.
21. *Carron	$\frac{1}{63360}$	2,006	132	**15.2**	2.3	Latitude 56° 1′	Ordnance survey, Scotland, 39.
22. *Theiss	$\frac{1}{200000}$	11,250	625	**18.0**	2.2	Latitude 46° 25′	Kistelek und Szegedin.
23. Mississippi	$\frac{1}{316800}$	31,680	2,640	**12.0**	2.7	South of Baton Rouge	4-sheet map, Lower Mississippi.

TABLE B.

River.	Scale.	mb	w	$\frac{mb}{w}$	$\frac{mb}{d}$	Place.	Map.
1. Tallapoosa	$\frac{1}{125000}$	6,600	400	**16.5**	2.3	Latitude 33° 40′	Tallapoosa, Ga.
2. Tallapoosa	$\frac{1}{125000}$	9,360	520	**18.0**	2.0	Latitude 33° 15′	Ashland, Ala.
3. Coosa	$\frac{1}{125000}$	13,200	750	**17.6**	2.4	Latitude 33° 40′	Springville, Ala.
4. Locust Fork	$\frac{1}{125000}$	8,580	330	**26.0**	2.0	Latitude 33° 50′	Birmingham, Ala.
5. Locust Fork	$\frac{1}{125000}$	10,000	400	**25.0**	2.5	Latitude 33° 35′	Jasper, Ala.
6. French Broad	$\frac{1}{125000}$	25,080	990	**25.0**	1.6	Latitude 36° 5′	Morristown, Tenn.
7. French Broad	$\frac{1}{125000}$	13,200	850	**15.5**	2.0	Latitude 35° 55′	Knoxville, Tenn.
8. Nolichucky	$\frac{1}{125000}$	15,180	600	**25.0**	1.7	Latitude 36° 10′	Morristown, Tenn.
9. Tennessee	$\frac{1}{125000}$	19,800	1,000	**19.8**	2.0	Latitude 35° 45′	London, Tenn.
10. Tennessee	$\frac{1}{125000}$	26,400	1,400	**19.0**	1.2	Latitude 35° 5′	Chattanooga, Tenn.
11. Hiwassee	$\frac{1}{125000}$	13,200	660	**20.0**	1.7	Latitude 35° 10′	Murphy, Tenn.
12. Cumberland	$\frac{1}{125000}$	10,000	500	**20.0**	2.8	Latitude 36° 50′	Cumberland Gap, Ky.
13. Cumberland	$\frac{1}{125000}$	9,900	330	**30.0**	1.4	Latitude 36° 45′	Williamsburg, Ky.
14. Powell	$\frac{1}{125000}$	11,220	600	**18.7**	3.0	Latitude 36° 33′	Cumberland Gap, Ky.
15. Red River	$\frac{1}{125000}$	13,200	400	**33.0**	2.3	Latitude 37° 50′	Beattyville, Ky.
16. Kentucky	$\frac{1}{125000}$	20,340	550	**18.5**	3.0	Latitude 37° 40′	Beattyville, Ky.
17. Connasauga	$\frac{1}{125000}$	18,480	450	**41.1**	3.0	Latitude 34° 40′	Dalton, Ga.
18. Colorado	$\frac{1}{250000}$	20,000	1,000	**20.0**	3.0	Latitude 38° 35′	La Sal and San Rafael, Utah.
19. Colorado	$\frac{1}{250000}$	21,000	600	**35.0**	2.5	Latitude 37° 0′	Escalante, Utah.
20. New	$\frac{1}{125000}$	18,000	700	**25.7**	3.0	Latitude 37° 10′	Dublin, Va.
21. Dniester	$\frac{1}{200000}$	23,611	694	**34.0**	2.2	Latitude 48° 52′	43° 49°, Kolomea.
22. Dniester	$\frac{1}{200000}$	40,000	1,111	**36.0**	2.2	Latitude 48° 3′	46° 48°, Soroki.
23. Marne	$\frac{1}{80000}$	17,190	255	**67.0**	3.3	Latitude 48° 48′	État-Major, 48.
24. Seine	$\frac{1}{80000}$	47,110	1,067	**44.0**	2.5	Near the mouth	État-Major, 30.
25. Seine	$\frac{1}{80000}$	51,000	600	**85.0**	3.5	Near Paris	État-Major, 48.
26. Seine	$\frac{1}{80000}$	29,535	933	**31.7**	2.0	Between Paris and sea	N. E., État-Major, 47.
27. Oise	$\frac{1}{80000}$	13,333	267	**49.9**	(?)	Latitude 49° 1′	N. O., État-Major, 48.
28. Agout	$\frac{1}{80000}$	11,067	167	**66.3**	1.8	Latitude 43° 43′	N. E., État-Major, 230.
29. Tarn	$\frac{1}{80000}$	9,533	467	**20.4**	1.7	Latitude 44° 6′	S. O., État-Major, 206.
30. Waag	$\frac{1}{75000}$	5,625	375	**15.0**	2.0	Latitude 49° 10′	Rosenburg u. Rutka.

crease in the width is a greater hindrance to bending than an increase in the thickness in the proportion of the square of the increment, doubled width being four times as effective for resistance as doubled depth.

Strictly, in the case of the turning river, it is a matter of momentum. Could we have a single thread of water flowing along a curved or crooked channel, its turns would be made with ease, however sharp; but actual streams are always made of many threads of water side by side, and when the outer thread seeks to rebound from the outer bank at a turn, the momentum of the inner threads drives it along in a course that is kept straighter in proportion as there are more inside threads of current. A column of men, marching, turns as easily with twenty files abreast as with one, but only because the inside man has been trained to stand still and merely rotates on his axis until his companions have got around the corner. The inside threads of river current have no volition, no training to stop and wait for their neighbors outside. Their momentum carries them along and their number makes the turn longer, the meander belt wider.

In view of these considerations let us return to our table of meander belts and consider the stream width in each case. The table is here reproduced, omitting fall and discharge, and introducing two new columns, headed w for width of stream in feet, and $\frac{mb}{w}$, or ratio of meander belt to width of stream.

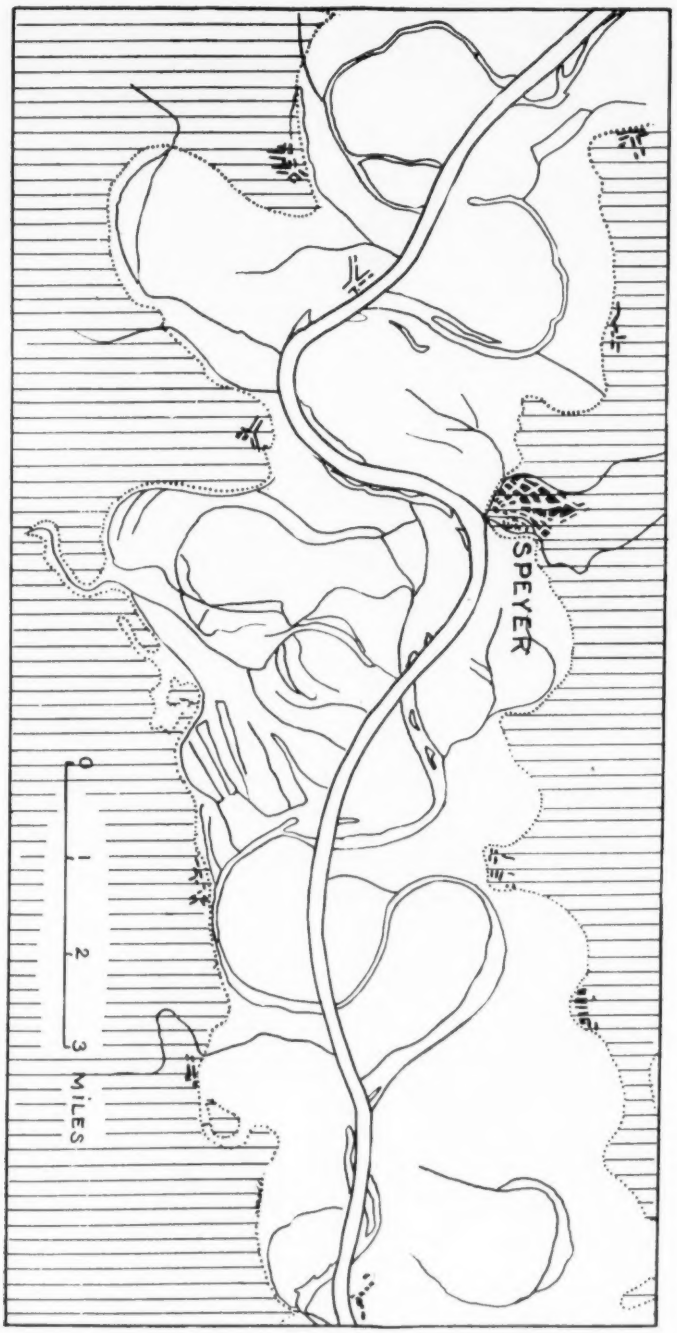
River.	mb	w	$\frac{mb}{w}$	Place.
Matfield.....	450	30	15.0	Elmwood, Mass.
Oder.....	4 688	243	19.3	Kosel, Silesia.
Mississippi.....	55,000	2,830	19.4	Greenville, Miss.
Etowah	4,000	260	15.4	Canton, Ga.
James.....	8,448	660	12.8	Buchanan, Va.
Greenbrier.....	9,768	528	18.5	Alderson, W. Va.
Shenandoah ..	9,000	803	11.2	Near Potomac River
Tennessee.....	26,400	1,400	18.9	Chattanooga, Tenn.

Here is a good suggestion of a constant value in the column $\frac{mb}{w}$. But these rivers were selected under constraint when I was trying to utilize the best meanders that occurred near points where measurements of volume had been made. We are now able to select the best flood plains, and on these the best-developed meanders on any American or European maps that are accessible. The list follows as Table A. No stream has been excluded because its ratio was discordant. Many were rejected because of too small a value of the quantity $\frac{mb}{d}$, which gives the ratio of measures at meanders across and along the general river course; d represents the distance from meander to meander along the river axis. Starred rivers have cuts-off near.

The mean meander ratio is **17.6.** Study would doubtless remove some of the discordancies. The Rhine near Speyer and Worms, as the accompanying map shows, is a corrected stream, flowing in an artificial channel. The width of the meander belt may be measured from the old course, which still subsists, but the width of the river, measured on the artificial channel, which is confined between walls, is probably less than that of the uncorrected stream that made the meanders. This must tend to give an excessive value to the meander ratio.

It is interesting to observe in the case of the Rhine that the flood-plain width is not far from the width of the maximum meander belt.

The small ratio for the Mississippi at Baton Rouge is of interest with the opener character of the meanders in the lower course, where each arm of the river seems to point away from the next arm upstream instead of swinging around toward it. A little farther and the river stops swinging, to rush headlong



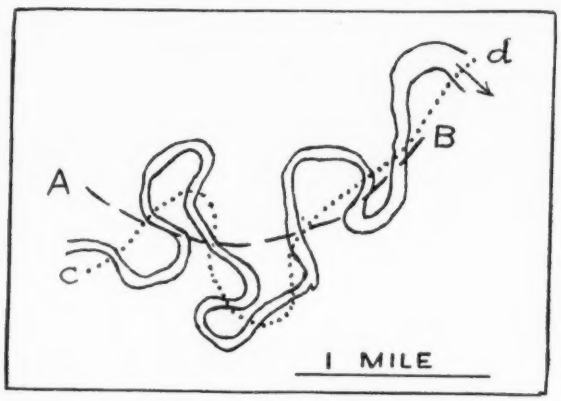
The Rhine—A Corrected Meandering Stream

to the Gulf. The same opening out of meanders is noticed at Teesmouth and at the mouth of Seine and Dniester. The Panaro and Tagliamento come from their mountains overburdened with waste, and flow where it encumbers them in braided courses. The meandering stretch examined for each comes just below.

The facts ascertained by an examination of incised rivers are of sufficient interest to be now summarized in Table B.

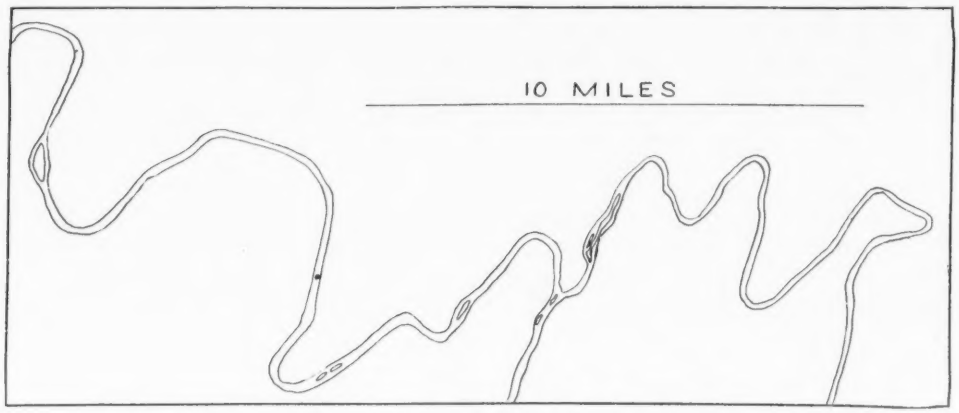
The ratios run high. The average is **30.6**. Of all single rivers studied, the most interesting is the Dniester, with two measurements in each table. On the flood plain its ratios are **14.3** and **16.4**, and **34** and **36** where incised in the mountains. This is the same story as the longer tables tell of meander belts that widen out as they are incised in the rocks. It is to be noted that the river widens in the mountains, but the meander belt widens even more.

The exceptionally high ratios for Seine, Oise, and Marne go with the quite as exceptional symmetrical form. The Seine and Marne at least are quite as regular in their curvature as the Mississippi and quite of the flood-plain type. Note the large ratio $\frac{mb}{d}$. One might look for some local cause for all three did not the Agout, in the southwest of France, agree with them. Yet farther from Paris, Seine 24 and Seine 26 have values nearer normal. Is there interference with the streams by walling or dredging sufficient to explain this abnormal ratio? The great use of these streams for interior commerce might easily lead to a deepening of the channels at important points, and this would tend to narrow the stream and increase the meander ratio. The width tabulated for Seine 25 is suspiciously small. This would be comparable to what has happened to the Rhine at Mannheim in the process of "correcting" that stream. Seine 25 and 26 have their channels divided in two by a continuous line of islands, as in the Rhine in the Schiefergebirge, but more numerous. Very likely the Agout has too great a width assigned to its meander belt because of what I may call *compounding* of meanders, which very often makes it hard to measure flood-plain streams, notably the Koros on the plain of Hungary. The accompanying sketch of the Forth at Stirling illustrates this compounding. *Cd* may be regarded as the immediate axis and *A B* as the original axis. Such forms are common in the small tributaries along the central valley of the Mississippi.



The Forth at Stirling

In contrast to the curves of the Seine just noted are the stiff zigzags of the Nolichucky and French Broad shown on figure 5, as characteristic of inherited incised meanders. We must think of them as once swinging freely on a low-lying plain, but their incision in the rising land has set them rushing swiftly from turn to turn where once they swung in curves. The deep-cut meanders of the canyons of the Colorado appear from the maps to have nothing of stiffness or zigzag in their form.



French Broad and Nolichucky

It should be remembered that there are no true maxima for incised meander belts, since the cut-offs that rebuke the flood-plain stream when it undertakes ventures beyond its strength cannot readily occur when the stream bed is sunk deep in the rocks. The average difference of the flood-plain meander ratios from their mean is 3.3, of the incised meander ratios 12.3. There is no necessary limit to meander belts when incised, and soft rocks may facilitate high values.

THE WIDTH OF STREAMS

A brief examination either of a stream or a good map shows width to be very variable, not merely from foot to foot, from mile to mile. The most striking case that I have come across is on the Prestonburg, Ky., topographic sheet, where Levisa Fork of the Big Sandy flows for 10 miles or so in the southeast part of the map with a pretty constant width of over 500 feet in a deep, narrow valley. Then for 5 or 6 miles near Prestonburg it is barely 300 feet wide, though the valley is opener. Later it again widens out to the northward. If correctly mapped, it is clear that such variations would be important in meander studies.

If examination be continued through the seasons, the changes at one place become very great. The fluctuations in height of the water at a river gage are incessant, not merely through the year and month, but even through the day. As the slopes that confine the stream waters to right and left are gentle, the fluctuations in width are much greater than the changes on the gage. At high stages particularly an inch rise on the gage may increase the width of the river by many feet. In drought stages there is a narrow thread of water meandering on its own law in the bottom of the stream bed; at flood time the whole plain is submerged, and if there is then a tendency to meander, it is in long curves wholly unlike those the river is familiar with. The meanders of the maps are, of course, those of the stream bed. This is confined by steeper slopes, but still by slopes, causing it to vary in width as the water falls or rises. It is in this bed that the stream is when it carves its meanders, and if it varies there in width, so is the stream bed the scene of varying meander tendencies. Some of the irregularities in the resultant meanders are due to this cause. For the Preliminary Map of the Lower Mississippi the stage adopted for mapping is about one-third

of extreme oscillation above low water. For the United States topographic maps such details probably do not come within the limits of accuracy aimed at.

It would be desirable to know for every stream the width at which the water stands longest. In practice the measurements taken from the maps are subject to errors so much greater than this uncertainty of stage that no great harm results from its neglect. In field-work mapping should have regard to this point.

CONCLUSION

There are already depicted on good maps many river courses to which the criteria suggested may be applied. Abnormal results should be traceable to local conditions. But the vast majority of meandering rivers are too small to admit accurate measurement from such mapping as they are likely to get. The essential measurements are easily made on the ground.

It is now evident that the Matfield, the study of which has led to this discussion, has not a typical flood plain. A 30-foot river demands a 540-foot meander belt. This it hardly has between its bluffs, as a glance at the map will show. The river is still cutting at these bluffs to remove the restraint they now exercise on its meander system. Though its plain may be called incised, it is not due to the incision of meanders inherited from a previous cycle, but they are rather now first developing on a somewhat uneven surface of glacial deposits. The presence side by side of oxbows and sloughs with the close-pressed course against the bluffs suggests some distinctive epithet like hindered, embarrassed, or bluff-bound, rather than simply undeveloped.

PEARY'S WORK IN 1901-1902

AFTER four years of brilliant explorations in the far north, Peary has returned to the United States and his last Arctic campaign is ended. A summary of his work during the first three years of this last expedition appeared in the October, 1899, and October, 1901, numbers of this magazine. His work during the past year is summarized in the following modest report to Mr H. L. Bridgman, secretary of the Peary Arctic Club:

OFFICIAL REPORT BY ROBERT E. PEARY

Dated Sydney, September 7, 1902

Left at Erik Harbor, on the Ellesmere coast, August 29; the party reached Payer Harbor September 16; crossing Rosse Bay partly by sledge and partly by boat, then walked across Bedford Pin Island.

About a week later my Eskimo began to fall sick, not one escaping. By November 19, six adults and one child were dead; nearly all the others very weak, but out of danger. Early in January Eskimo came across from Anoritok, bringing news of the ravages of a fatal epidemic through the tribe. Word was sent back by these scouts for as many of the survivors as could to come to me, and by the end of the month they began arriving.

In February a large depot of dog-food was established near Cape Louis Napoleon, some 60 miles north of Sabine.

March 3 my advance party of six sledges, in charge of Henson, left for Conger.

March 6 I started with the main party of 18 sledges, leaving Percy in charge at Payer Harbor.

Conger was reached in 12 marches, arriving within an hour or two of the advance party.

My supporting party of Eskimo returning from Conger brought down the instruments, chronometers, and Arctic library.

Eight marches more took us to Cape Hekla. The north end of Robison Channel was all open water to the Greenland coast, and lakes of water extended northward as far as could be seen from Black Cape and Cape Rawson.

From Hekla another supporting party returned.

April 1 I started northward over the polar sea with Henson, four Eskimo, and six sledges.

Old floes covered deep with snow and intersected with rubble ridges and lanes of young ice were encountered from the moment we left the ice foot. The same kind of traveling (except the lanes of young ice) was found by the English expedition of 1876.

After six marches open leads and floes in motion were encountered. Two natives were sent back.

As we advanced the floes became smaller, the pressure ridges on a grander scale, and the open leads more frequent. Each day's march was very tortuous and our general course deflected west by the character of the ice.

Finally at 84° 17′ north latitude, northwest of Hekla, the polar pack became impracticable and further efforts to advance were given up. New leads and pressure ridges, with foggy weather, made our return in some respects more trying than the advance. Hekla was regained April 29 and Conger May 3. Leaving Conger May 6, Cape Sabine on the 17th, a few days later, I went north as far as Cape Louis Napoleon to complete the survey of Dobbin Bay, returning the first of June.

A proposed trip westward across Ellesmereland was prevented by open water in Buchanan Bay. The ice broke up earlier than in 1901, and Payer Harbor was blockaded almost continuously.

The *Windward* bored her way through the ice and entered the harbor on the morning of August 5, and got out the same afternoon, with scarcely 15 minutes to spare before the harbor was closed by the ice. Forcing our way across Smith Sound, my Eskimo with their belongings were landed in Inglefield Gulf, and several days devoted to hunting walrus for their winter subsistence; then the *Windward* started south, reaching and leaving Cape York the afternoon of August 28.

Calling at Godhaven, Greenland, and Cape Haven, Baffinland, the *Windward* arrived at Choteau Bay, Labrador, September 14 and sent dispatches.

The summer voyage has been without mishap, and the *Windward*, with her new engines, has made as good time as the larger and more powerful ships that have been going north the past ten years.

The year at Payer Harbor was passed comfortably, though the anxious strain caused by the ravages of disease among my faithful people was not light. Food was abundant, and our supply of musk ox and deer meat continuous throughout the year.

The northern sledge trip in the spring was arduous, but not marked by special exposure, suffering, or danger more than is necessarily incident to serious Arctic work.

The equipment and personnel was satisfactory, and further advance was vetoed by insuperable natural conditions.

The *Windward* has on board the instruments, chronometers, and Arctic library abandoned by the Greely expedition at Conger, numerous specimens in natural history, bear, musk ox, rein-

deer, and walrus skins, skeleton of a two-horned narwhal, a rare Arctic specimen; also living specimens of musk ox, walrus, Arctic hare, and Eskimo dogs.

Anchor and chain lost by *Erik* last summer are on board.

The *Fram* left Godhaven about August 20, bound home. She has been in Jones Sound, from whence it is understood explorations were made to the northwest. One death, a fireman, is reported since 1899. Others on board said to be well.

The little schooner *Forgetmenot*, caught in the ice at Cape Haven last year, is now on her way to St Johns.

(Signed) PEARY.

SUMMARY OF PEARY'S WORK

Mr Peary has devoted practically the whole of the last twelve years to Arctic work. He announces that he has now retired from Arctic exploration and will hereafter devote his energies to his profession, civil engineering. The results of his long labors in the far north are most important. He has proved Greenland an island and mapped its northern coast line; he has defined and mapped the islands to the north of Greenland, known as the Greenland Archipelago; he has shown that an ice-covered Arctic ocean probably extends from the Greenland Archipelago to the North Pole; he has accurately defined the lands opposite the northwestern coast of Greenland, Grant Land, Grinnell Land, and Ellesmereland; he has reached the most northerly known land in the world; he has gained the most northerly point yet reached on the Western Hemisphere, 84° 17′; he has studied the Eskimo as only one can who has lived with them for years; he has added much to our knowledge of Arctic fauna and flora; of the musk ox, the Arctic hare, and the deer; the notes he has made during the past years will benefit meteorology and geology—all these are some of Lieutenant Peary's achievements during the twelve years he has so valiantly battled in the far north. But, above all, Mr Peary has given the world a notable example of a brave and modest man who, in spite of broken limbs and most terrible physical suffering and financial discouragements, has unflinchingly forced to a successful end that which he had decided to accomplish.

To Mrs Peary, the able seconder of her husband's plans, and to Mr H. L. Bridgman, the efficient secretary of the Peary Arctic Club, and the loyal members of that club, much credit is due.

G. H. G.

GEOGRAPHIC NOTES

RECLAMATION SERVICE

ON June 17, 1902, what is known as the "Reclamation Law" was signed by the President. This appropriates the receipts from the sale and disposal of public lands in certain states and territories to the construction of irrigation works for the reclamation of arid lands. Thirteen states and three territories are named in the bill, viz, the states of California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming, and the territories of Arizona, New Mexico, and Oklahoma. The funds made available are those received during the fiscal years ending June 30, 1901 and 1902, and subsequent years. The amount has not been specifically given by the Treasury Department, but is unofficially stated to be three millions for 1901 and four and a half millions for 1902.

The work authorized by the law is that of surveying and examining opportunities for water storage and diversion of large rivers, and also the location and construction of the works when found to be feasible. The cost of these is to be returned to the reclamation fund and used again in construction.

In 1888 the Director of the United States Geological Survey was authorized to make examinations of this character, and extensive surveys were begun at the time. The appropriation for these was cut off at a later date, excepting as regard the topographic surveys of the catchment basins. In 1894, however, appropriations were made for measuring the streams and determining the water supply, and the funds for this purpose have been increased until now, the year ending June 30, 1903, there is available the sum of $200,000.

The information obtained under the authority of the law of 1888 and of subsequent acts has been published in the reports of the Geological Survey. In obtaining the data a considerable number of skilled engineers have been employed and a separate division formed, known as the Hydrographic Branch of the Geological Survey.

Upon the passage of the Reclamation Law, the Secretary of the Interior, to whom is entrusted the administration of the reclamation fund, received from the Director of the Geological Survey a plan for putting the law into immediate effect, and on July 8, these suggestions being approved, active work was begun. This is in effect a continuation and enlargement of the work of the Hydrographic Branch. Instead of organizing a new bureau, the Secretary authorized the gradual creation within the Hydrographic Branch of a corps of engineers to be known as the "Reclamation Service," these men retaining their connection with the Geological Survey, but receiving additional assistants and being assigned to a larger field of work.

The great advantage derived from the creation of the Reclamation Service within a well-established bureau is that it is able to obtain the services of skilled and experienced men, and does not pass through the vicissitudes incident to the formation of new rules and regulations and the originating of precedents for all of its operations. The Reclamation Service as thus established is able to proceed at once with the work contemplated by the law with the least amount of time consumed in preparation, and it is safe to say that at least a year has been saved in this way. The new men added are young engineers, graduates of professional schools, selected after competitive examination from the eligible lists of the Civil Service Commission.

The official in charge of the work as designated by law is the Secretary of the Interior, Hon. Ethan A. Hitchcock. He has referred the surveys and examinations and making of recommendations for construction to the Director of the Geological Survey, Hon. Charles D. Walcott. The charge of the work is by him entrusted to the Chief Engineer, Mr F. H. Newell. The latter is also Chief Hydrographer of the Geological Survey, and is conducting stream measurements in various parts of the United States. The principal engineer next in rank is Mr Arthur P. Davis, well known for his work on the hydrography of Nicaragua and Panama.

Before the passage of the Reclamation Law detailed surveys had been begun in Montana on St. Mary's Lakes and outlet, in Nevada on the Truckee and Carson Rivers, in Colorado on the diversion of Gunnison River, and in Arizona on the San Carlos and Salt River reservoirs. After the passage of the law this work was pushed forward more vigorously, the field parties being increased. Examinations have been begun on Yellowstone River in Montana, on the Snake River in Idaho, on the Bear River in

Utah, on the South Platte River near Sterling, Colo., on Grand River near Grand Junction, Colo., to take water into Utah, and on Colorado River in southern California and western Arizona. A number of other important projects are awaiting consideration and will be taken up as rapidly as experienced men can be obtained through the Civil Service Commission.

This law is regarded as one of the most important in the development of the public lands of the West. It is of concern not merely to the western people, but even more so to those of the entire country who are seeking homes or employment or who have goods to be sold or transported to the new communities which will be formed. The successful administration of the law means a great change in the western half of the United States through the upbuilding of homes in regions which are now desert but where there are great possibilities latent. The men having the work in charge are keenly alive to the responsibilities resting upon them and are endeavoring to guard the work from destructive influence and keep it on a sound, business-like basis. For this reason, great emphasis has been placed upon the necessity of keeping the personnel strictly on civil-service lines, employment and promotion being dependent upon efficiency and experience. In the same way the selection of projects for consideration and report is being made upon the basis only of public importance and feasibility, the refunding of the cost and the settlement of the greatest number of people upon the reclaimed lands.

COAL IN ALASKA

DR C. WILLARD HAYES, Geologist in Charge, U. S. Geological Survey, is in receipt of a telegraphic report from the Collier expedition announcing that they had reached Seattle en route to Washington, and giving the leading results of the season's work. The party of three, with Mr Arthur J. Collier in charge, left Washington early in May, to explore portions of Yukon Valley, in which the existence of coal was rumored. The telegraphic report indicates that they have discovered large bodies of good coal adjacent to the river and within reach of transportation facilities.

THE SVERDRUP ARCTIC EXPEDITION

PRESS dispatches from Christiania and Stavanger, Norway, convey gratifying announcements of the success of the Arctic expedition of the *Fram*, led by Captain Otto Sverdrup.

The *Fram* sailed from Christiania June 24, 1898, with a crew comprising Captain Sverdrup, commander; Naval Lieutenant Victor Baumann, astronomer; Lieutenant Guy Ysachsen, cartographer; Dr H. Svendsen, meteorologist; Dr Ed. Bay, zoölogist; Dr Herman G. Simons, botanist; Dr P Schell, geologist; Dr Draskrug, surgeon, together with nine seamen. The *Fram* is owned by the Norwegian Government, which not only granted Captain Sverdrup permission to use the vessel, but supplied him with the funds requisite for outfitting the expedition.

The primary purpose of the expedition was to explore and map the northeastern and northern coasts of Greenland, and to trace the connection between Cape Washington and Independence Bay; but on learning that a considerable part of this task had been already accomplished by Peary, Sverdrup changed his design, and undertook to survey the unknown coasts of Ellesmereland, with adjacent portions of the Arctic Archipelago. Great difficulties were encountered. For nearly three years the *Fram* lay almost motionless in the ice of Jones Sound, despite repeated attempts to free the craft by both sawing and blasting.

Game was found in abundance; a hundred musk oxen were killed for food. The most serious loss suffered by the party was that of the death of Surgeon Draskrug, whose body was buried in the ice. Several cases of illness were successfully treated by Captain Sverdrup after the death of the surgeon.

According to the meager reports issued through the press dispatches, "the districts explored were the southern and western coasts of Ellesmereland and the hitherto unknown districts west of that region. The boiler of the *Fram* shows signs of usage, but everything is in good order."

The vessel left Gothaab, Greenland, August 16, but an accident to the machinery compelled her to make the homeward passage entirely under sail. On September 28 the *Fram* entered Christiania harbor under the escort of warships and pleasure steamers, and was saluted by the fort and welcomed by thousands of spectators. The latest advices announce a reception to Sverdrup and his companions given by the Geographical Society on September 30, at which the Captain was decorated with the Order of the Grand Cross of St Olaf, while Seaman Peter Henniksen (who had participated also in the Nansen Arctic expedition) received a gold medal, and other members of the expedition received silver medals. The dispatches quote Sir Clements R. Markham, president of the Royal Geographical Society of Great Britain, as regarding Captain Sverdrup's expedition as the most important since that of Sir John Franklin.

The geographic results of the Sverdrup expedition remain to be described. According to Sir Clements Markham, as reported in the dispatches, the expedition skirted three thousand miles of coast, of which half was newly discovered land. Unquestionably the surveys will supplement those of Peary and others, and with them bring into the domain of actual knowledge a large part of Arctic America.

THE BROOKS ALASKAN EXPEDITION

DR A. H. BROOKS, of the U. S. Geological Survey, has just reported by wire the successful termination of a notable season's work in Alaskan exploration. Entering by way of Cook Inlet, he so laid his course as to divide the largest unexplored area in Alaska. This he traversed, skirting the base of Mount McKinley and making fresh observations on this culminating point of the North American continent, coming out on the Tananak. The brief telegraphic report indicates that the plans for the work were successfully carried out, without serious casualties.

REPORTED ENTRANCE OF LHASSA

IT is currently reported in Hamburg that one of the seven Japanese Buddhist priests who have been endeavoring to enter Tibet has succeeded, and that he is now in Lhassa. It is said that this priest went in from Darjiling, and that two others are approaching the sacred city from Mongolia. The third party passed up the Yangtse Valley toward the frontier about a year ago, but their present whereabouts are unknown.

Miss Eliza R. Scidmore, Foreign Secretary of the National Geographic Society, is in Hamburg as a delegate from the Society to the Thirteenth International Oriental Congress.

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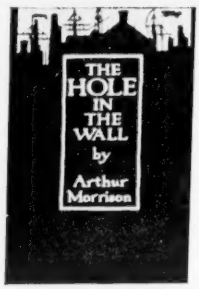

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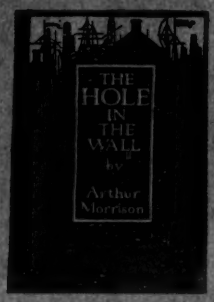

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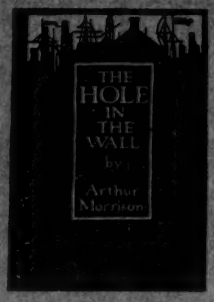

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